Attachment 7: Economic Analysis – Flood Damage Reduction Costs and Benefits

Project Description. This project, *Stormwater Source Control in the CABY Region,* will construct green infrastructure stormwater facilities to reduce sediment, pollutants, and erosive peak flood flows, while increasing groundwater infiltration and storage in the Yuba River watershed. It will also provide a highly exportable, innovative solution for controlling downstream flood risk. The project will be constructed at two public sites in the disadvantaged communities of Nevada City and Grass Valley—the Nevada County Rood Administrative Center (Rood Center) and the Yuba River Charter School (YRCS). Green infrastructure components that will be constructed include: two rain gardens, two vegetated swales, 22,000 square-feet of pervious pavement, and two retention wetlands to capture and infiltrate stormwater runoff from 160,000 square feet of parking lot area.

These facilities mimic nature's way of cleaning and storing stormwater and provide not only economic, water quality and hydrology benefits, but also aesthetic and habitat values. In addition, the project has an innovative and robust monitoring component to quantitatively measure benefits, incorporates education and outreach activities for a range of audiences, and coordinates with other such efforts throughout the state to promote early learning and replication throughout the CABY and greater Sierra Nevada regions.

Project's Economic Costs. The project cost in 2009 dollars is $885,865. These costs would fund planning, design, labor, equipment, and materials necessary to implement the project. Ongoing operating costs are not expected to change when the project is constructed. This has been our experience at the Rood Center for Phase I: the cost to operate and maintain the green infrastructure has been the same as the cost for traditional infrastructure. Table 10 lists the estimated value of the costs, by category, in the years they would occur, and calculates their total present value.

Expected Flood Damage Reduction Benefits.
This discussion of flood damage focuses on qualitative economic benefits of reduced flood flows. Quantitative estimates are provided for reductions in flood volumes. Research conducted during the development of this proposal showed that, while it is feasible to quantify reduced stormwater volumes, it is currently very difficult to quantify the economic benefits of these reductions even on a local scale (Center for Neighborhood Technology, American Rivers 2010). Because this project is in the headwaters region, flood benefits accrue both locally (for example avoided costs of culvert expansions), as well as downstream through the central valley and delta regions. We discuss these benefits in narrative form.

Historic Flood Damage
Historically, major floods have occurred in the lower elevation regions of the Yuba River Watershed about once every decade. Major floods have been recorded since 1839, with the most recent devastating flood occurring in 1997. Numerous inundations have caused loss of life and significant property damage in the lower reaches of the Yuba Watershed. For example, according to the U.S. Army Corps of Engineers[1], Yuba River flooding in 1983 caused damages estimated at $11 million (1983 dollars). The Yuba flood in February 1986 caused a fatality and forced about 24,000 people to evacuate. California settled flood claims for $464 million (1986 dollars). The Yuba flood of 1995

[1] Yuba River Basin, General Reevaluation Study, US Army Corps of Engineers, January 2008.

caused flood damages of about $25 million (1995 dollars) to private properties, public buildings and infrastructure, farming (crop, livestock, and nursery losses), and roads. More recently, the January 1997 flood caused one of the largest evacuations in California history, left hundreds of people homeless, tens of thousands of acres inundated, hundreds of homes damaged, and four fatalities. Property damages from this flood were estimated at $41 million in 1997 dollars (USACE, 2008).

Since the early 1990s, the lower Yuba watershed has been partially protected by a flood control system of levees. Upstream storage facilities were constructed on the Yuba in 1970 in an attempt to increase flood protection. However, the current system does not provide adequate defense against flood-level flows. Creative solutions to improving flood management are critical for the health, safety, and economic stability of communities in this region. This project will demonstrate a highly exportable solution to local flooding, which, once adopted at a large scale, will provide substantial flood-control benefits.

Without-Project Conditions

Without this project, 5.9 million gallons of runoff from parking lots and roofs at the two project sites would carry sediment and pollutants into the Yuba River, contributing to erosive peak flows and increasing the danger of flood events in the lower watershed. In addition, because of rapid rates of local development, the incremental costs of increased stormwater will soon add up to necessary infrastructure upgrades. Local costs of managing this runoff will include: increased culvert sizes, local flooding of adjacent neighbors and increased maintenance attributable to larger volumes of stormwater.

Rood Center. The Nevada County Rood Center is a county building in Nevada City, a restored and charming Gold Rush-era mining town in the upper foothills of the Sierra. Surrounding the Rood Center is a 200,000 square foot parking lot, which drains directly into Deer Creek and the Yuba River. Last year, this site was retrofitted with green infrastructure facilities that currently capture approximately one-third of the runoff (more than 2 million gallons per year). The County plans to expand the site to include additional parking. Building upon their experience with Phase I of the project, Nevada County is very interested in managing stormwater onsite and demonstrating the benefits of these techniques. Consequently the County will provide matching funds to create a pervious concrete parking area as well as a rain garden to capture water from areas of existing impervious asphalt. Without this project, conventional methods would be used to construct the new parking area, and impervious pavement would be installed, with curbs positioned to direct approximately 1 million gallons of runoff each year into Deer Creek and the Yuba River.

Yuba River Charter School. The YRCS was founded in 1994 and currently serves 280 students (K - 8) and 30 staff members. The school has outgrown its current location and begun construction of a new campus on approximately 13 acres off of Rough and Ready Highway in Grass Valley, CA (also in Nevada County, about 6 miles from the Rood Center). The site consists of zoned commercial/industrial and zoned residential/agricultural parcels. Land use on the surrounding parcels is mixed, and includes a large hospice facility adjacent to the new campus. If stormwater is not managed on-site, more than 2 million gallons of runoff will flow through the campus annually, from impervious surfaces of at both YRCS and the adjacent hospice center.

Impervious Cover and Population Growth. According to state Department of Finance projections, the population of counties in the CABY IRWMP region increased 16 percent between 1990 and 2000

and is expected to grow an additional 20 percent by 2020. Impervious cover increases two to four times faster than population growth (Otto et al, 2002), thus expected population growth in the CABY region will result in a 20 to 80 percent increase in impervious cover within the next decade. **By 2020, an additional 7.6 to 15.3 square miles of impervious cover is expected in Nevada County alone** (population 97,118; area 957 square miles; density 101 people/square mile; impervious cover 19 square miles [from relation in Bird et al 2000]). The surrounding CABY IRWMP region is similar in development, population trends and climate, so a corresponding increase in impervious cover for the CABY region is likely. In our further calculations of stormwater volumes, we will use the central estimate of 11 square miles of additional impervious cover added in Nevada County by 2020, which represents 38 square miles of additional impervious cover by 2020 in the CABY region.

Population growth in Nevada County, and the resulting impervious cover will result in **35,000 acre feet of additional stormwater runoff annually by 2020** (annual rainfall of 60 in/year). If 50 percent of these projects included on-site stormwater infiltration, 17,500 acre-feet of stormwater would be infiltrated and stored high in the watershed. The water savings in Nevada County from this investment in green infrastructure would supply the water needs of 35,000 households (ConSol 2010), or **enough water for one-third the current household use for the people of Nevada County.** For the CABY region, 66,000 acre-feet of stormwater would be infiltrated and stored, if 50 percent of future projects in the region adopted the LID strategies demonstrated by this project.

Outreach and Education. Without this project, the CABY region will continue to lack green infrastructure stormwater facilities and opportunities for effective outreach and education around demonstration projects will remain limited. While this impact may seem small currently, the Sierra Nevada is among the fastest growing regions in California. The increase in impervious cover that results from population growth would have a substantial negative impact, not only in the CABY region but also in downstream areas (see below). For this reason, promotion of on-site stormwater management is one of the goals of the CABY IRWMP. Education around the benefits resulting from our project will lead to an increase in the implementation of green infrastructure stormwater facilities in the CABY region and across the Sierra Nevada. The proliferation of these facilities in the upper watershed would significantly reduce the risk of floods and their associated costs downstream. For example, a study conducted in 2006 showed that, considering only downstream road culverts, the use of conservation design techniques upstream avoids $3.3 million in costs of culvert replacement or upgrades. Also, the sum of downstream flood mitigation and infrastructure benefits amounts to $380–590/developed acres following conservation design practices (Johnston, Braden, and Price, 2006).

<u>With-Project Conditions</u>

As stated above, if implemented this project will result in the capture and treatment of 5.9 million gallons of stormwater runoff annually. In addition, it will be one of few examples of green infrastructure stormwater management in the Sierra foothills, and will expand the body of knowledge available about the benefits of green infrastructure stormwater facilities, and will increase opportunities to access this information. This in turn will lead to an increase in the construction of low-impact development facilities, positively impacting flood risk in downstream areas.

Construction of green infrastructure components has already begun at the Rood Center, including two rain gardens, a vegetated bio-swale with underground retention system, pervious pavement parking areas and a pervious pavement walkway with interpretive signs. For this second phase of the

project, an additional rain garden and pervious pavement parking area will be constructed. The existing features capture and treat 2 million gallons of runoff annually. The expanded components will allow the site to capture and treat runoff from 100,000 square feet of parking lot (3.7 million gallons of stormwater) annually. The installation is highly visible –the Rood Center is the highest-use county facility, and the parking lot is the largest in the area.

Green stormwater catchment elements at YRCS will include: two rain gardens, two vegetated swales, pervious parking, walkways, and assembly areas and two retention wetlands. Each year, 2.2 million gallons of stormwater will be captured from 60,000 square feet of parking lot and roof at YRCS.

A study conducted in 2004 showed that on-site stormwater management resulted in flood-mitigation benefits, including reduced frequency, area, and impact of flooding events (Braden and Johnston, 2004). A second study, conducted in 2006, concluded that downstream infrastructure benefits from flood reduction. These benefits include reduced expenditures on bridges, culverts and other water-related infrastructure (Johnston, Braden, and Price, 2006).

Local, Regional, and Statewide Benefits

The residents of the Yuba River Watershed, the CABY region, and the Sierra Nevada will benefit from the implementation of this project. Local residents within the Yuba River Watershed will likely benefit from the reduction of flood risk starting with the first major storm event after the stormwater facilities are constructed. Residents of the CABY region and the Sierra Nevada will benefit from the outreach and education activities that will begin during project implementation and continue into the future via signage and web postings.

Table 10- Annual Cost of Flood Damage Reduction Project

(All costs should be in 2009 Dollars)

Project: Stormwater Source Control in the CABY IRWMP Region

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 6 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009							$0	1.000	$0
2010	$375,000						$375,000	0.943	$353,625
2011	$65,000						$65,000	0.890	$57,850
2012	$350,000						$350,000	0.840	$294,000
2013	$200,000						$200,000	0.792	$158,400
2014	$30,000						$30,000	0.747	$22,410
								…	
Project Life								…	
							Total Present Value of Discounted Costs (Sum of Column (i))		$886,285
							Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries		

Comments: Operational Costs are unchanged with and without the project.

(1) The incremental change in O&M costs attributable to the project.